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(54) **SLEEP STATE VIDEO INTERFACE OF AN INFORMATION HANDLING DEVICE**

(75) Inventors: **Song Wang**, Cary, NC (US); **Howard Locker**, Cary, NC (US); **John Miles Hunt**, Raleigh, NC (US); **John Weldon Nicholson**, Cary, NC (US)

(73) Assignee: **Lenovo (Singapore) PTE. LTD.**, New Tech Park (SG)

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(51) **Int. Cl.**

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H04N 21/41	(2011.01)
G06F 1/16	(2006.01)
G06F 1/20	(2006.01)
G06F 1/26	(2006.01)
H04N 21/414	(2011.01)

(52) **U.S. Cl.**

CPC ***G06F 1/3215*** (2013.01); ***G06F 3/14*** (2013.01); *G06F 1/1616* (2013.01); *G06F 1/1632* (2013.01); *G06F 1/1654* (2013.01); *G06F 1/203* (2013.01); *G06F 1/266* (2013.01); *G06F 1/3218* (2013.01); *G06F 1/3265* (2013.01); *G06F 1/3287* (2013.01); *G09G 2330/022* (2013.01); *H04N 21/4122* (2013.01); *H04N 21/4126* (2013.01); *H04N 21/41407* (2013.01)

(58) **Field of Classification Search**

CPC .. G06F 1/1616; G06F 1/1632; G06F 1/1654; G06F 1/3218; G06F 1/3265; G06F 3/14; G06F 1/266; G06F 1/32; G06F 1/3287; G06F 1/203; H04N 21/4126; H04N 21/41407; H04N 21/4122

USPC 713/323

See application file for complete search history.

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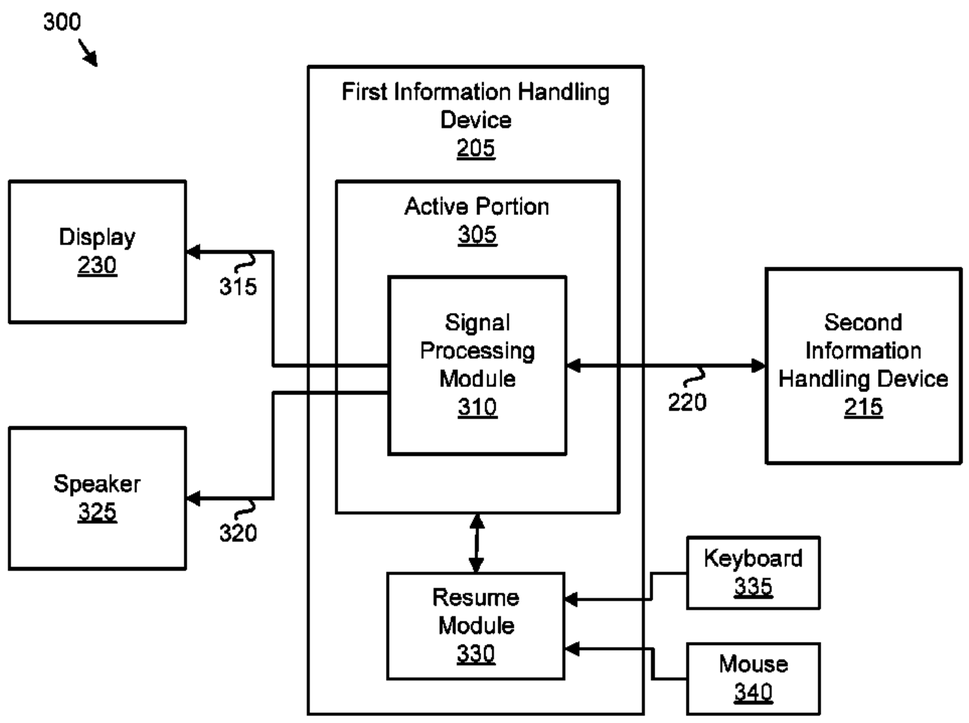
Primary Examiner — Xuxing Chen

(74) *Attorney, Agent, or Firm* — Kunzler Law Group

(57) **ABSTRACT**

An apparatus for a sleep state video interface of an information handling device includes a storage device storing machine-readable code and a processor executing the machine-readable code. The apparatus includes a notification module receiving a sleep notification to place an information handling device into a sleep state. The information handling device receives a video signal. The apparatus includes a sleep module entering the information handling device into the sleep state in response to the notification module receiving the sleep notification. The video signal passes through the information handling device to a display as the information handling device is in the sleep state.

18 Claims, 6 Drawing Sheets



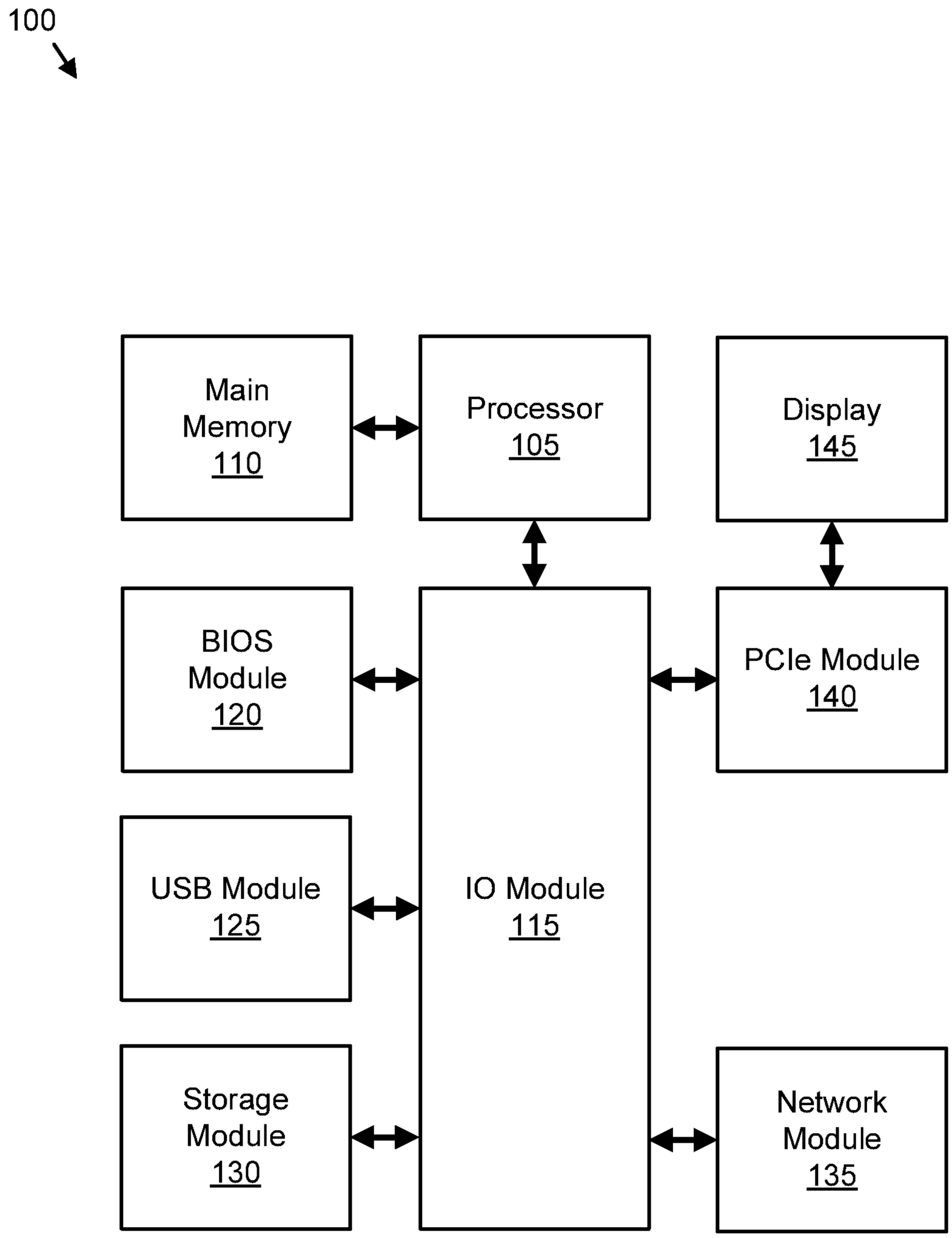

100
Main Memory 110
Processor 105
Display 145
BIOS Module 120
IO Module 115
PCIe Module 140
USB Module 125
Storage Module 130
Network Module 135

FIG. 1

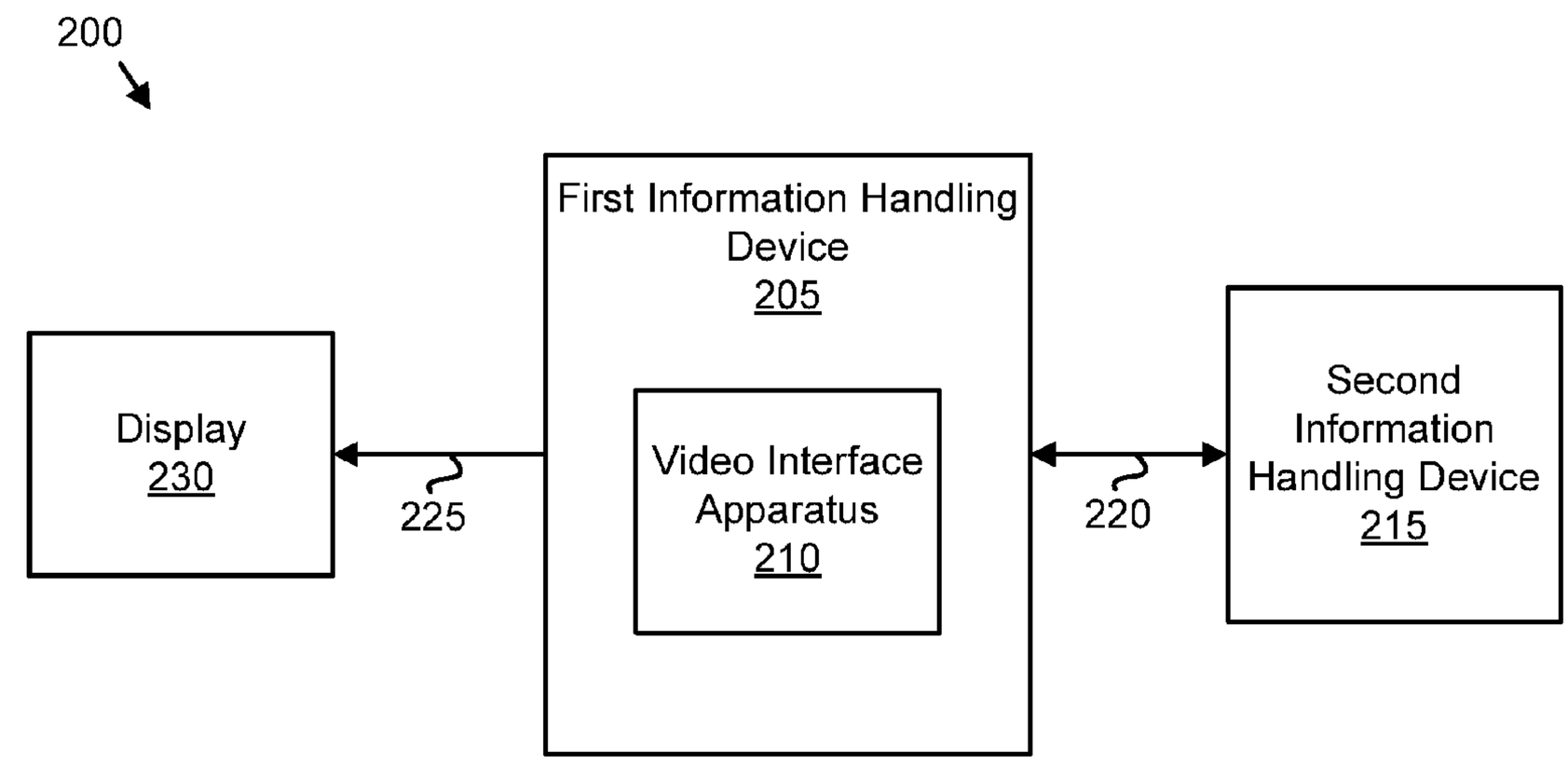

200
First Information Handling Device
205
Display
230
225
Video Interface Apparatus
210
220
Second Information Handling Device
215

FIG. 2

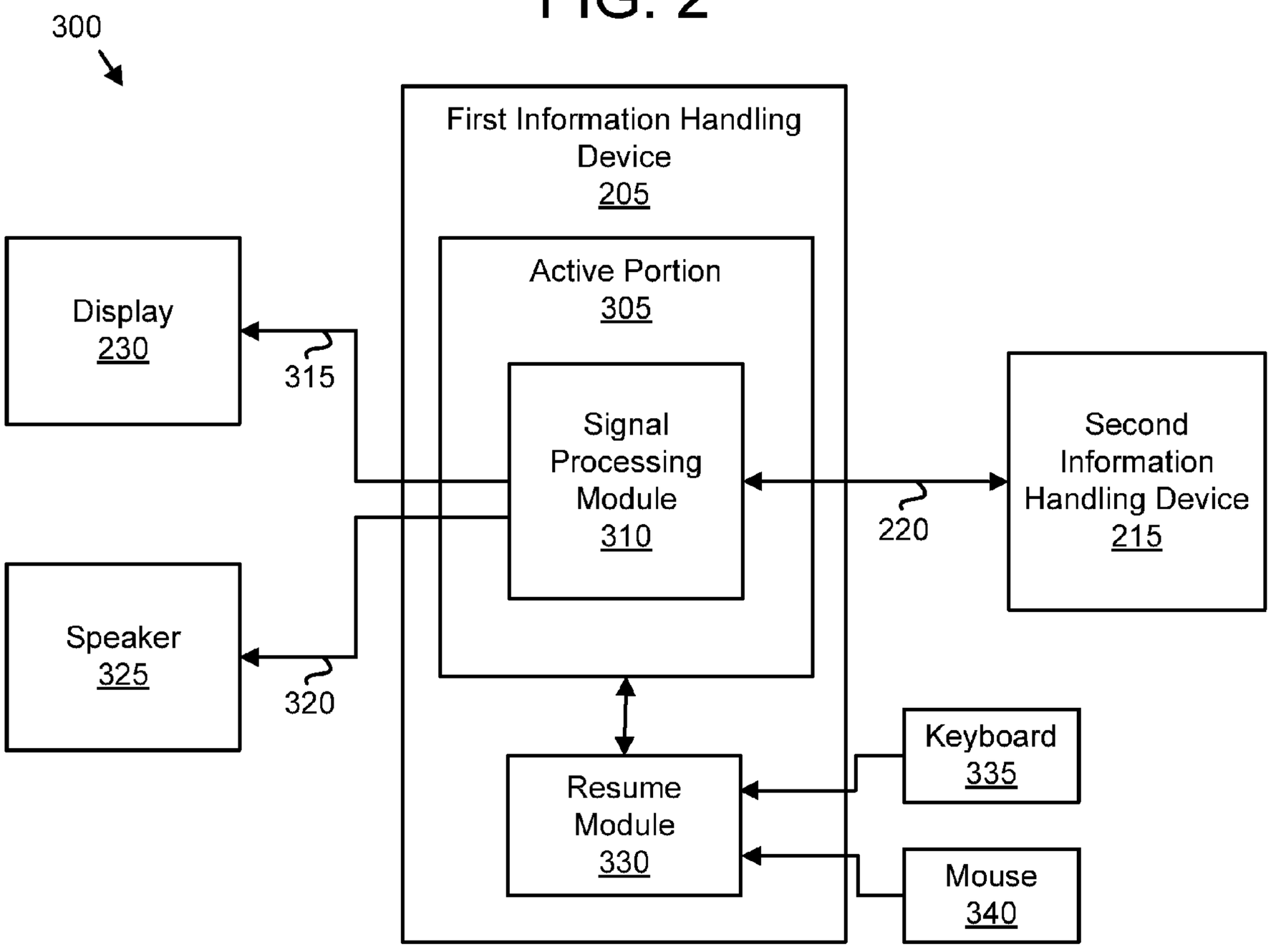

300
First Information Handling Device
205
Active Portion
305
Display
230
315
Signal Processing Module
310
220
Second Information Handling Device
215
Speaker
325
320
Resume Module
330
Keyboard
335
Mouse
340

FIG. 3

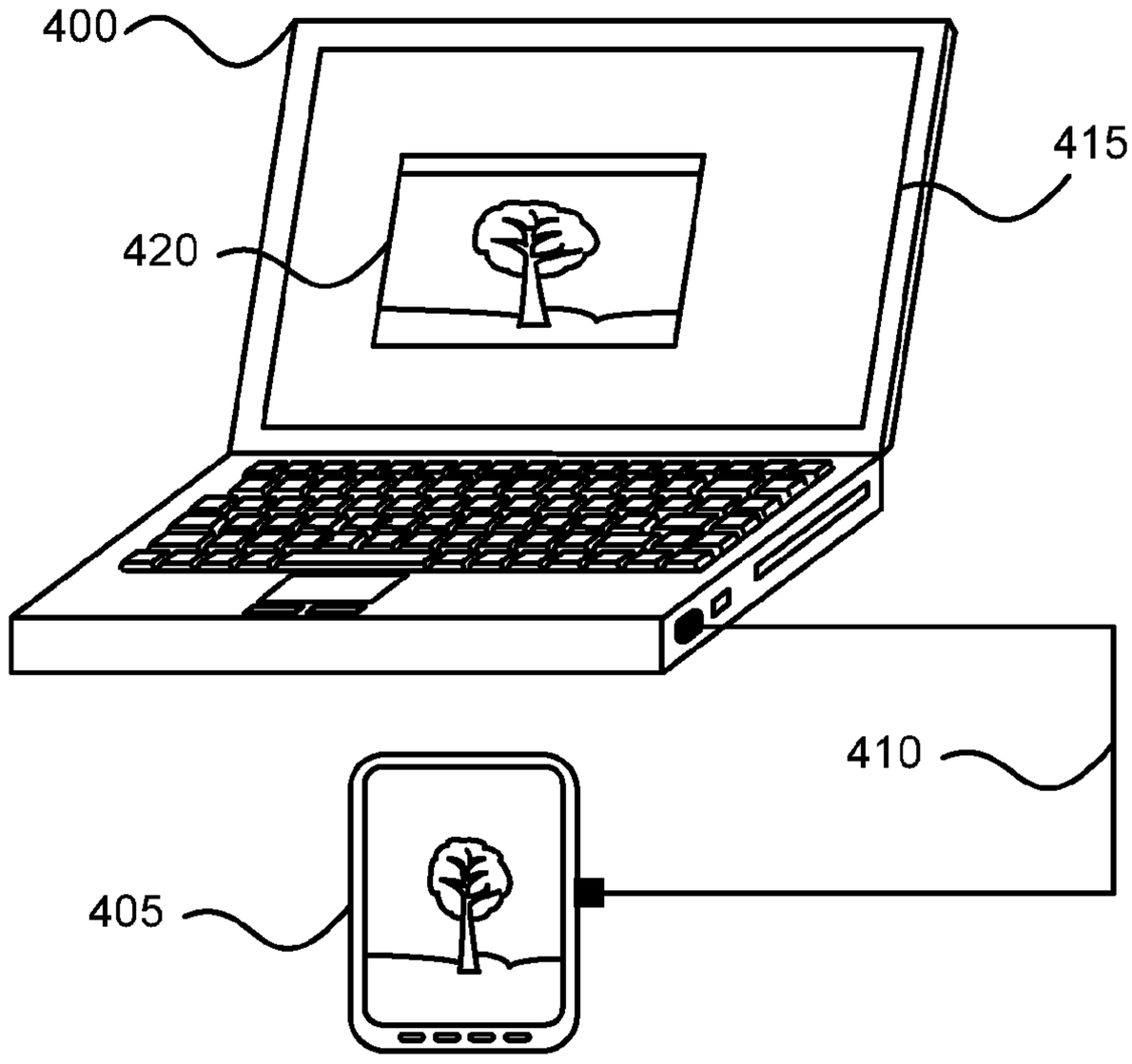


FIG. 4A

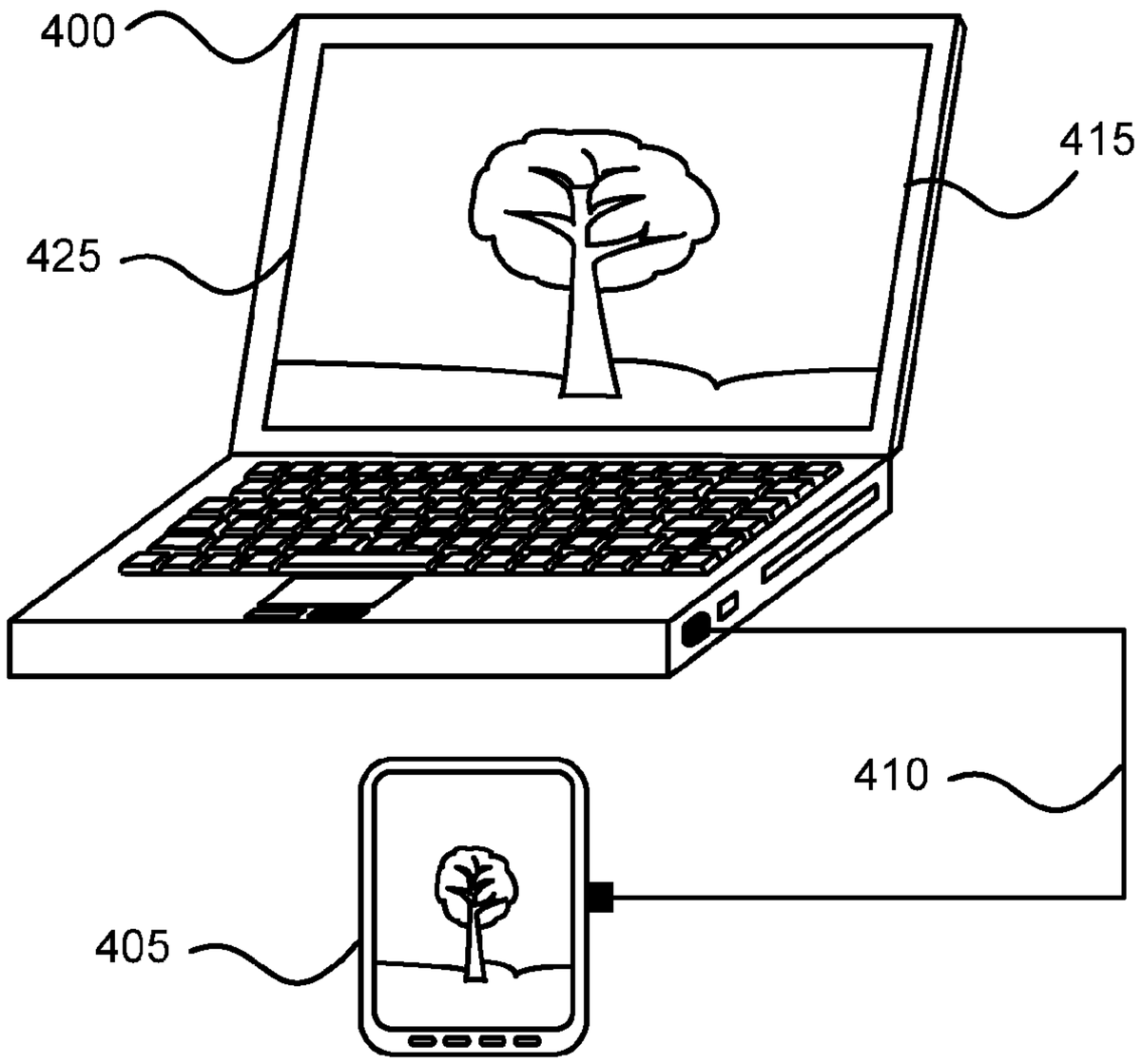


FIG. 4B

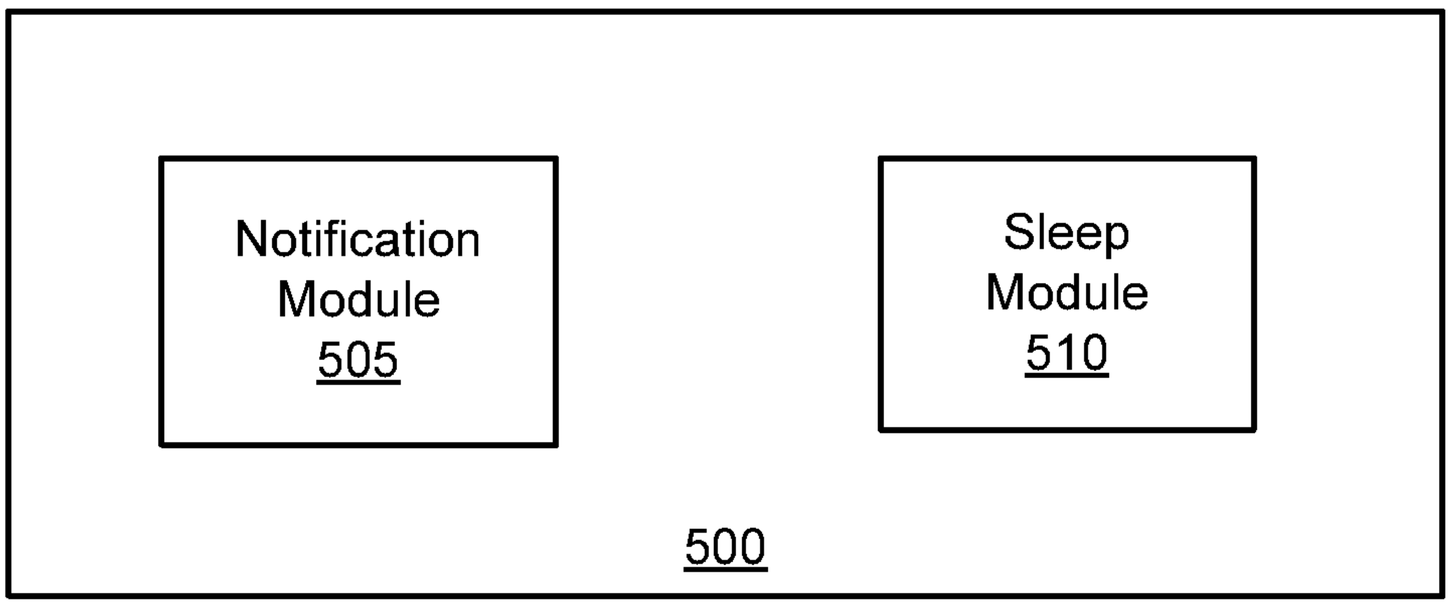

Notification Module 505
Sleep Module 510
500

FIG. 5

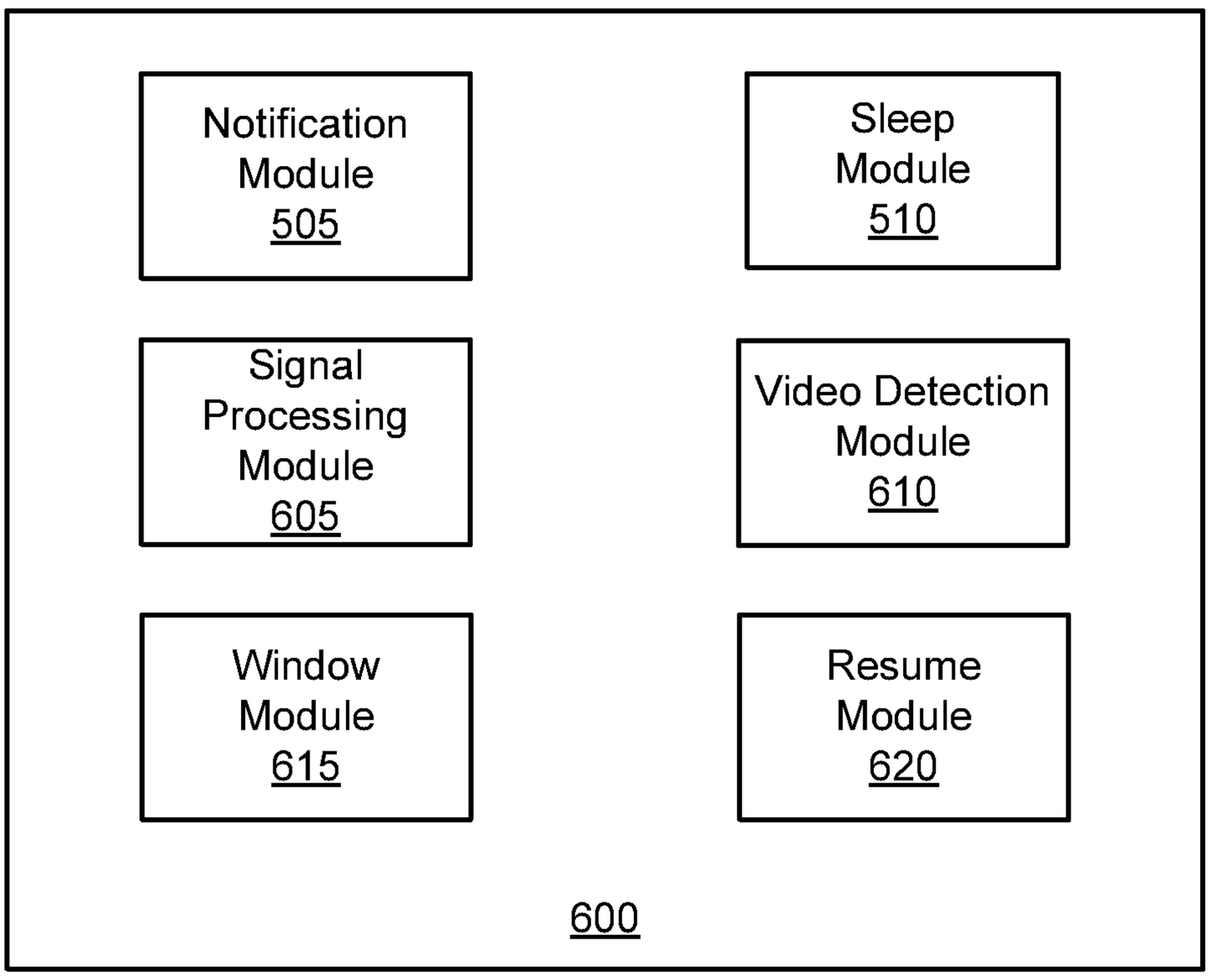

Notification Module 505
Sleep Module 510
Signal Processing Module 605
Video Detection Module 610
Window Module 615
Resume Module 620
600

FIG. 6

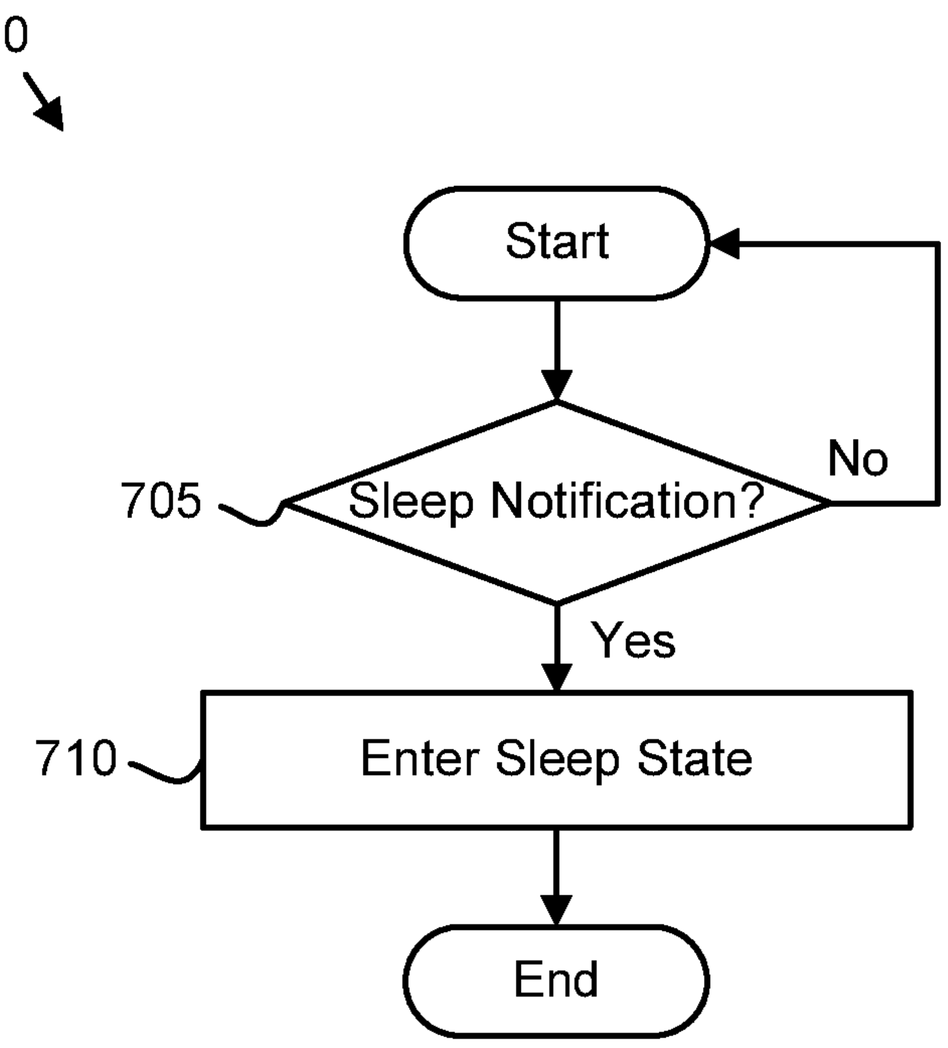

700
Start
705
Sleep Notification?
No
Yes
710
Enter Sleep State
End

FIG. 7

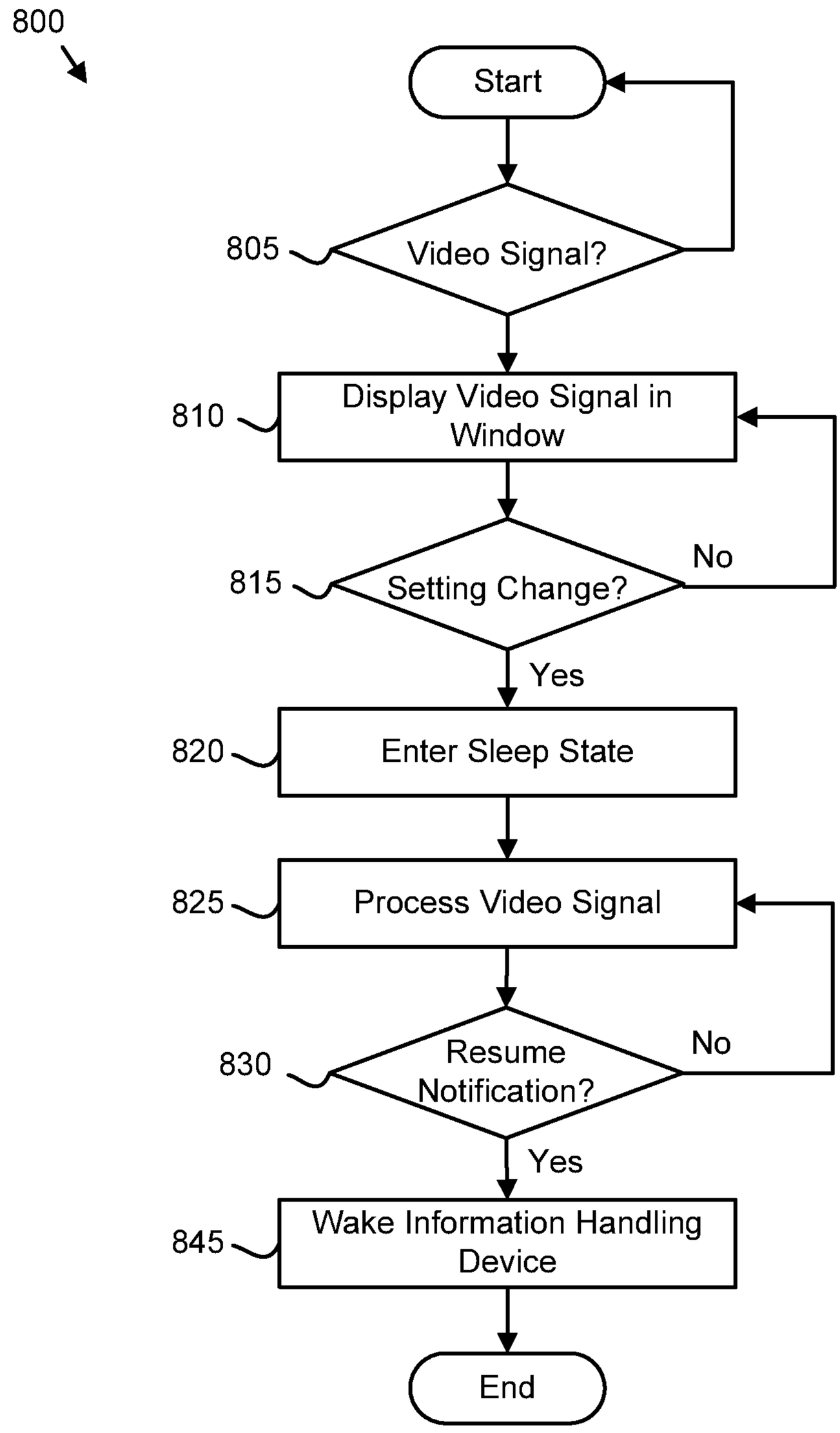

800
Start
805
Video Signal?
810
Display Video Signal in Window
815
Setting Change?
No
Yes
820
Enter Sleep State
825
Process Video Signal
830
Resume Notification?
No
Yes
845
Wake Information Handling Device
End

FIG. 8

SLEEP STATE VIDEO INTERFACE OF AN INFORMATION HANDLING DEVICE

FIELD

The subject matter disclosed herein relates to a video interface and more particularly relates a sleep state video interface of an information handling device.

BACKGROUND

Description of the Related Art

The use of portable information handling devices, such as smartphones and personal desktop assistants ("PDA"s), has proliferated, and with it, the capabilities of these portable information handling devices. For example, a user may store and stream various kinds of content on the user's smartphone. Current portable information handling devices such as smartphones and tablet computers often have video output capabilities which allow them to connect to devices having video input such as monitors and televisions.

Often, personal computers and laptops lack video input ports, such as HDMI ports, leaving a user without the option of displaying video from his or her mobile device. Furthermore, even information handling devices that include some form of video input typically receive video input while operating at full power.

BRIEF SUMMARY

Based on the foregoing discussion, the inventors have recognized a need for an apparatus, system, and method for a sleep state video interface of an information handling device. Beneficially, such an apparatus, system, and method would place an information handling device into a sleep state while a video signal passes through the information handling device to a display.

The embodiments of the present subject matter have been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available information handling devices. Accordingly, the embodiments have been developed to provide a method, apparatus, and system for a sleep state video interface of an information handling device.

An apparatus is provided with a storage device storing machine-readable code, a processor executing the machine-readable code, and a plurality of modules configured to functionally execute the steps for a sleep state video interface of an information handling device. These modules in at least a portion of the described embodiments include a notification module and a sleep module.

In one embodiment, the notification module receives a sleep notification to place an information handling device into a sleep state. The information handling device, in one embodiment, receives a video signal. In one embodiment, the sleep module enters the information handling device into the sleep state in response to the notification module receiving the sleep notification. In one embodiment, the video signal passes through the information handling device to a display as the information handling device is in the sleep state.

A method is also presented; in the disclosed embodiments, the method substantially includes the steps to carry out the functions presented above with respect to the operation of the described apparatus. In one embodiment, the method includes receiving a sleep notification to place an information handling device into a sleep state. The information handling device in one embodiment, receives a video signal. In one embodiment, the method includes entering the information handling device into the sleep state in response to receiving the sleep notification. The video signal, in one embodiment, passes through the information handling device to a display as the information handling device is in the sleep state.

A computer program product including a storage device storing machine readable code executed by a processor to perform operations is also presented. In one embodiment, operations include receiving a sleep notification to place an information handling device into a sleep state. The information handling device in one embodiment, receives a video signal. In one embodiment, the operations include entering the information handling device into the sleep state in response to receiving the sleep notification. The video signal, in one embodiment, passes through the information handling device to a display as the information handling device is in the sleep state.

References throughout this specification to features, advantages, or similar language do not imply that all of the features and advantages may be realized in any single embodiment. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic is included in at least one embodiment. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the embodiments may be combined in any suitable manner. One skilled in the relevant art will recognize that the embodiments may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments.

These features and advantages of the embodiments will become more fully apparent from the following description and appended claims, or may be learned by the practice of the embodiments as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

A more particular description of the embodiments briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only some embodiments and are not therefore to be considered to be limiting of scope, the embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of an information handling device in accordance with the present subject matter;

FIG. **2** is a schematic block diagram illustrating one embodiment of a system for a sleep state video interface of an information handling device in accordance with the present subject matter;

FIG. **3** is a schematic block diagram illustrating another embodiment of a system for a sleep state video interface of an information handling device in accordance with the present subject matter;

FIG. **4**A is a perspective view illustrating one embodiment of a smartphone transmitting a video signal to a display of a laptop computer in accordance with the present subject matter;

FIG. **4**B is a another perspective view of the smartphone and the laptop computer of FIG. **4**A in accordance with the present subject matter;

FIG. **5** is a schematic block diagram illustrating one embodiment of an apparatus for a sleep state video interface of an information handling device in accordance with the present subject matter;

FIG. **6** is a schematic block diagram illustrating another embodiment of an apparatus for a sleep state video interface of an information handling device in accordance with the present subject matter;

FIG. **7** is a schematic flow chart diagram illustrating one embodiment of a method for a sleep state video interface of an information handling device in accordance with the present subject matter; and

FIG. **8** is a schematic flow chart diagram illustrating another embodiment of a method for a sleep state video interface of an information handling device in accordance with the present subject matter.

DETAILED DESCRIPTION

As will be appreciated by one skilled in the art, aspects of the embodiments may be embodied as a system, method or program product. Accordingly, embodiments may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit," "module" or "system." Furthermore, embodiments may take the form of a program product embodied in one or more storage devices storing machine readable code. The storage devices may be tangible, non-transitory, and/or non-transmission.

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in machine readable code and/or software for execution by various types of processors. An identified module of machine readable code may, for instance, comprise one or more physical or logical blocks of executable code which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of machine readable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network. Where a module or portions of a module are implemented in software, the software portions are stored on one or more storage devices.

Any combination of one or more machine readable medium may be utilized. The machine readable storage medium may be a machine readable signal medium or a storage device. The machine readable medium may be a storage device storing the machine readable code. The storage device may be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, holographic, micromechanical, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing.

More specific examples (a non-exhaustive list) of the storage device would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this file, a computer readable storage medium may be any tangible medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

A machine readable signal medium may include a propagated data signal with machine readable code embodied therein, for example, in baseband or as part of a carrier wave. Such a propagated signal may take any of a variety of forms, including, but not limited to, electro-magnetic, optical, or any suitable combination thereof. A machine readable signal medium may be any storage device that is not a computer readable storage medium and that can communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device. Machine readable code embodied on a storage device may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber cable, Radio Frequency (RF), etc., or any suitable combination of the foregoing.

Machine readable code for carrying out operations for embodiments may be written in any combination of one or more programming languages, including an object oriented programming language such as Java, Smalltalk, C++ or the like and conventional procedural programming languages, such as the "C" programming language or similar programming languages. The machine readable code may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment, but mean "one or more but

not all embodiments" unless expressly specified otherwise. The terms "including," "comprising," "having," and variations thereof mean "including but not limited to," unless expressly specified otherwise. An enumerated listing of items does not imply that any or all of the items are mutually exclusive, unless expressly specified otherwise. The terms "a," "an," and "the" also refer to "one or more" unless expressly specified otherwise.

Furthermore, the described features, structures, or characteristics of the embodiments may be combined in any suitable manner. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments. One skilled in the relevant art will recognize, however, that embodiments may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of an embodiment.

Aspects of the embodiments are described below with reference to schematic flowchart diagrams and/or schematic block diagrams of methods, apparatuses, systems, and program products according to embodiments. It will be understood that each block of the schematic flowchart diagrams and/or schematic block diagrams, and combinations of blocks in the schematic flowchart diagrams and/or schematic block diagrams, can be implemented by machine readable code. These machine readable code may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the schematic flowchart diagrams and/or schematic block diagrams block or blocks.

The machine readable code may also be stored in a storage device that can direct a computer, other programmable data processing apparatus, or other devices to function in a particular manner, such that the instructions stored in the storage device produce an article of manufacture including instructions which implement the function/act specified in the schematic flowchart diagrams and/or schematic block diagrams block or blocks.

The machine readable code may also be loaded onto a computer, other programmable data processing apparatus, or other devices to cause a series of operational steps to be performed on the computer, other programmable apparatus or other devices to produce a computer implemented process such that the program code which execute on the computer or other programmable apparatus provide processes for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks.

The schematic flowchart diagrams and/or schematic block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of apparatuses, systems, methods and program products according to various embodiments. In this regard, each block in the schematic flowchart diagrams and/or schematic block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions of the program code for implementing the specified logical function(s).

It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the Figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more blocks, or portions thereof, of the illustrated Figures.

Although various arrow types and line types may be employed in the flowchart and/or block diagrams, they are understood not to limit the scope of the corresponding embodiments. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the depicted embodiment. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted embodiment. It will also be noted that each block of the block diagrams and/or flowchart diagrams, and combinations of blocks in the block diagrams and/or flowchart diagrams, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and machine readable code.

FIG. **1** is a schematic block diagram illustrating one embodiment of an information handling device **100**. The information handling device **100** includes a processor **105**, a memory **110**, an IO module **115**, a basic input/output system ("BIOS") module **120**, a universal serial bus ("USB") module **125**, a storage module **130**, a network module **135**, a peripheral component interconnect express ("PCIe") module **140**, and a display **145**. One of skill in the art will recognize that other configurations of an information handling device **100** or multiple information handling devices **100** may be employed with the embodiments described herein.

The processor **105**, memory **110**, the IO module **115**, the BIOS module **120**, the USB module **125**, the storage module **130**, the network module **135**, the PCIe module **140**, referred to herein as components, may be fabricated of semiconductor gates on one or more semiconductor substrates. Each semiconductor substrate may be packaged in one or more semiconductor devices mounted on circuit cards. Connections between the components may be through semiconductor metal layers, substrate-to-substrate wiring, circuit card traces, and/or wires connecting the semiconductor devices.

The memory **110** stores computer readable programs. The processor **105** executes the computer readable programs as is well known to those skilled in the art. The computer readable programs may be tangibly stored in the storage module **130**. The storage module **130** may comprise at least one Solid State Device ("SSD"). In addition, the storage module **130** may include a hard disk drive, an optical storage device, a holographic storage device, a micromechanical storage device, or the like.

The processor **105** may include integrated cache to reduce the average time to access memory **115**. The integrated cache may store copies of instructions and data from the most frequently used memory **110** locations. The processor **105** may communicate with the memory **110**.

In addition, the processor **105** may communicate with the IO module **115**. The IO module **115** may support and communicate with the BIOS module **120**, the network module **135**, the PCIe module **140**, and the storage module **130**.

The PCIe module **140** may communicate with the IO module **115** for transferring data or power to peripheral devices. The PCIe module **140** may include a PCIe bus for

attaching the peripheral devices. The PCIe bus can logically connect several peripheral devices over the same set of connections. The peripherals may be selected from a printer, a scanner, or the like. The PCIe module **140** may also comprise an expansion card as is well known to those skilled in the art. In one embodiment, the PCIe module **140** is in communication with a display. Specifically, in one embodiment, the PCIe module comprises a PCIe expansion card in communication with the display. In one embodiment, the PCIe expansion card comprises a PCIe Mini Card. The display **145** may be a cathode ray tube ("CRT"), a liquid crystal display ("LCD") monitor, or the like.

The BIOS module **120** may communicate instructions through the IO module **115** to boot the information handling device **100**, so that computer readable software instructions stored on the storage module **130** can load, execute, and assume control of the information handling device **100**. The BIOS module **120** may comprise a coded program embedded on a chipset that recognizes and controls various devices that make up the information handling device **100**. The BIOS module **120** may refer to various approaches to providing a firmware interface for booting an information handling device **100**, including traditional BIOS, unified extensible firmware interface (UEFI), Open Firmware, and others. The BIOS module **120**, in one embodiment, includes a storage device that stores the relevant instructions for booting. The storage device may be a solid state storage device, such as Flash memory. The BIOS module **120** may be a solid state storage device with relevant code that is attached to a motherboard of the information handling device **100**.

The network module **135** may communicate with the IO module **115** to allow the information handling device **100** to communicate with other devices over a network. The devices may include routers, bridges, computers, printers, and the like. The USB module **125** may communicate with one or more USB compatible devices over a USB bus.

FIG. **2** depicts one embodiment of a system **200** for a sleep state video interface of an information handling device. The system **200** may allow a user to transmit video from one device **215**, such as a smartphone, to the display **230** of another device **205**, such as the display of a laptop or tablet computer. In addition, the system **200** may place the receiving device **205** into a sleep state to save power during the video transmission. The system **200** includes a first information handling device **205**, a second information handling device **215**, and a display **230**. The first information handling device **205** includes a video interface apparatus **210**.

Often, personal computers and laptops lack video input ports, leaving a user without the option of displaying video from another information handling device such as a mobile device. Furthermore, even information handling devices that include some form of video input typically receive video input while operating at full power. Consequently, in the depicted embodiment the first information handling device **205** includes a video input (e.g. a cable connection port) and the second information handling device **215** includes a video output. In one embodiment, the first information handling device **205** and the second information handling device **215** are coupled with a video connection **220** between the video output and video input. In one embodiment, the video connection **220** is a cable connection. In certain embodiments, the video connection is a two-way connection capable of transmitting data from the first information handling device **205** to the second information handling device **215** and from the second information handling device **215** to the first information handling device **205**. Consequently, each information handling device **205**, **215**, in one embodiment, may have both video input and video output capabilities.

The second information handling device **215** may transmit a video signal over the video connection **220**. A video signal, in one embodiment, includes digital video data and in certain embodiments, may also include digital audio data. The second information handling device **215** may transmit the video signal according to a digital video interface. In one embodiment, the digital video interface is a High-Definition Multimedia Interface (HDMI) interface, the video connection is an HDMI connection, and the video signal is an HDMI signal. In this embodiment, the first and second information handling devices **205** include HDMI ports for HDMI video input/output. In one embodiment, the digital video interface is a mobile high-definition link (MHL) interface. In other embodiments, the interface is a Digital Visual Interface (DVI) interface, a Firewire interface, or other suitable digital video interface. In one embodiment, the second information handling device **215** also includes and/or is in communication with a display.

In one embodiment, the second information handling device **215** transmits the video signal and the first information handling device **205** receives the video signal through the video connection **220**. The first information handling device **205** transmits, conveys, and/or transfers **225** the video signal to the display **230**. The display **230** may comprise one embodiment of the display **145** described above in relation to FIG. **1**. In one embodiment, the display **230** is separate from the first information handling device **205** and is connected to the first information handling device **205** by, for example, a cable connection. In another embodiment, the display **230** is part of and/or integrated with the first information handling device **205**. For example, the display **230** may be a laptop display, a tablet display, or the like.

In one embodiment, the video interface apparatus **210** enters the first information handling device **205** into a sleep state and allows the video signal to pass through the information handling device **205** while it is in the sleep state. As a result, the first information handling device **205** remains in a reduced power state while the video is displayed. The video interface apparatus **210** may enter the first information handling device **205** into the sleep state in response to various events such as a window of a user interface displaying the video on the first information handling device **205**, transitioning into a full screen mode, in response to the first information handling device **205** receiving the video signal, and/or the like.

The first information handling device **205** and/or the second information handling device **215** may include memory, a storage device storing computer readable programs, and a processor that executes the computer readable programs as is known to those skilled in the art. The first and/or second information handling devices **205**, **215** may comprise embodiments of information handling device **100** depicted in FIG. **1** or comprise at least a portion of the components of the information handling device **100**. In one embodiment, the second information handling device **215** is a portable or handheld device such as a personal desktop assistant ("PDA"), a tablet computer, a slate computer, an e-Book reader, a mobile phone, a smartphone, and the like. In one embodiment, the first information handling device **205** is a desktop computer, a portable computer, a tablet computer, a laptop computer, a server, a mainframe computer, and/or the like.

In one embodiment, all or a portion of the video interface apparatus **210** comprises a computer readable program stored and executed by the first information handling device **205**. In one embodiment, the video interface apparatus **210** includes an application executing on an operating system of the first information handling device **205** and/or is integrated with the operating system.

FIG. **3** depicts another embodiment of a system **300** for a sleep state video interface of an information handling device. FIG. **3** depicts the first information handling device **205** communicating with the second information handling device **215** by way of a video connection **220**, and the first information handling device **205** communicating with the display **230**. Moreover, these elements may be substantially similar to the like-named elements in FIG. **2**. In one embodiment, an active portion **305** of the first information handling device **205** remains powered on and active while the first information handling device **205** is in the sleep state. In one embodiment, the active portion **305** receives the video signal, processes and video signal, and transmits the video signal to the display **230** while the first information handling device **205** is in the sleep state, thus allowing the video signal to pass through the first information handling device **205** while it remains in the low power sleep state. FIG. **3** depicts one embodiment of the active portion **305** of the first information handling device **205** that remains powered on.

In one embodiment, the active portion **305** comprises an expansion card of the first information handling device **205**. In one embodiment, the expansion card is an mPCIe card and may comprise at least a portion of the PCIe module **140** depicted above in FIG. **1**. The active portion **305**, in one embodiment, includes a video input that may be substantially similar to the video input described above in relation to the first information handling device **205**. In the depicted embodiment, the active portion **305** includes a signal processing module **310**. The second information handling device **215** transmits the video signal to the signal processing module **310**. The signal processing module **310** may transmit and/or convey audio data of the video signal to a speaker **325** and may transmit and/or convey video data of the video signal to the display **230**. In one embodiment, the signal processing module **310** converts the video signal to a signal suitable for displaying by the display **230**. For example, in one embodiment, the signal processing module **310** converts an HDMI signal to a low voltage differential signal (LVDS).

In one embodiment, the second information handling device **215** comprises a portable information handling device that transmits a video signal in a mobile high-definition link (MHL) protocol. In this embodiment, the signal processing module **310** converts the MHL video signal from the second information handling device **215** to HDMI.

In one embodiment, the active portion **305** maintains power while the first information handling device **205** is in the sleep state. For example, in one embodiment, the active portion is an mPCIe expansion card that receives power from the host computer (the first information handling device **205**) through a pin on the PCI-e connector. In one embodiment, when the first information handling device **205** is asleep, the voltages are still available to the expansion card. In one embodiment, video processing of the signal processing module **310** is independent of the first information handling device **205**. The signal processing module **310**, in one embodiment, continues processing the video signal while the first information handling device **205** is in the sleep state. In one embodiment, processing the video signal refers to receiving the video signal, converting the video signal, and/or conveying the video signal to the display **230**. In one embodiment, the signal processing module **310** comprises a portion of the video interface apparatus **210**. In one embodiment, at least a portion of the video interface apparatus **210** is implemented on the active portion **305**.

The resume module **330**, in one embodiment, communicates with the active portion **305** through, for example, a serial connection or other suitable connection. In one embodiment, the resume module **330** communicates with one or more peripheral devices such as a keyboard **335** and a mouse **340**. In one embodiment, the resume module **330** is an embedded controller. In certain embodiments, the resume module **330** may detect and/or receive a predetermined signal from the mouse **340** and/or keyboard **335** to wake up the first information handling device **205** from the sleep state. The resume module **330** may wake the first information handling device **205** from the sleep state in response to the predetermined signal. For example, in one embodiment, the predetermined signal comprises a certain key combination or button press to wake the first information handling device **205**.

FIG. **4**A depicts one embodiment of a smartphone **405** transmitting a video signal to a display **415** of a laptop computer **400**. The laptop computer **400** and the smartphone **405** may be embodiments, respectively, of the first and second information handling devices **205**, **215** of FIGS. **2** and **3**. In the depicted embodiment, the smartphone **405** is connected to the laptop computer **400** with a video connection **410**. The smartphone **405**, in the depicted embodiment, plays a video and transmits the video signal comprising the video over the video connection **410** to the display **415** of the laptop computer **400**. In the depicted embodiment, the laptop computer **400** displays the video in a window **420** of a user interface of the laptop computer **400**. In the depicted embodiment, the window **420** occupies a sub region of an area of the display **415**.

The laptop computer **400** may enter the sleep state in response to a variety of events. FIG. **4**B depicts one embodiment of one such event. FIG. **4**B depicts another embodiment of the laptop computer **400** and smartphone **405** of FIG. **4**A. In the depicted embodiment, the laptop computer **400** displays the video from the smartphone **405** in a full screen mode **425** on the display **415**. In one embodiment, the laptop computer **400** may enter a sleep state in response to the window, in which the video is initially displayed, entering into a full screen mode **425**. For example, the user may trigger the window to enter into the full screen mode **425** and the laptop computer **400** may enter the sleep state in response to the window entering the full screen mode **425**.

FIG. **5** illustrates one embodiment of an apparatus **500** for a sleep state video interface of an information handling device. The apparatus **500** may comprise one embodiment of the video interface apparatus depicted in FIG. **2**. The apparatus **500** includes a notification module **505** and a sleep module **510**. FIG. **5** also refers to FIGS. **2** and **3**, like numbers referring to like elements.

The notification module **505**, in one embodiment, receives a sleep notification to place an information handling device **205** into a sleep state. The information handling device **205**, in one embodiment, comprises one embodiment of the first information handling device **205** depicted in FIG. **2**. The information handling device **205** may receive a video signal. In one embodiment, a second information handling device **215** transmits the video signal to the information handling device **205**. The second information handling device **215** may comprise one embodiment of the second information

handling device **215** depicted in FIG. **2**. In one embodiment, the video signal is an MHL signal, an HDMI signal or other digital video signal. In one embodiment, the video signal includes video comprises video data for a screen of the second information handling device **215**. Specifically, the video signal may be a continuous screen capture of the second information handling device **230** (e.g. showing video content the second information handling device **230** has/would have on its display). In one embodiment, the information handling device **205** communicates with and/or is integrated with a display **230** as described above.

The sleep notification, in one embodiment, is a signal, trigger, and/or notification to place the information handling device **205** in a sleep state. The sleep notification may include a predetermined event and/or a notification of a predetermined event. The sleep notification may originate from within the information handling device **205**, such as from an application executing on the information handling device **205**.

For example, in one embodiment, the sleep notification includes a setting change of an application and/or operating system executing on the information handling device **205**. In a further embodiment, the setting change may be a setting change on a window of a user interface of the information handling device **205**. The user interface may comprise a user interface of an application executing on the information handling device **205** and/or an operating system executing on the information handling device **205**.

The window, in one embodiment, displays video of the video signal on the user interface of the information handling device **205**. The setting change may comprise a size change of the window, a maximization of the window, the window entering into a full screen mode, or the like. For example, in one embodiment, the information handling device **205** executes a Windows® operating system from Microsoft® and the window is a window displayed by the operating system and/or an application running on the operating system. In one embodiment, the video transmitted by the second information handling device **215** is displayed in the window, which, as described above in relation to FIG. **4**A, may be sized initially as a sub region of the display **230**. In one embodiment, if a user and/or application maximizes the window (triggers the window to expand to cover an entire area of the display **230**) and/or causes the window to enter into a full screen mode, the sleep notification may comprise an indication that of the window becoming maximized and/or entering into the full screen mode. In one embodiment, the sleep notification may be generated, as described below, in response to detecting the information handling device **205** receive the video signal from the second information handling device **215**.

The sleep notification may also originate from a source external to the information handling device **205** such as from the second information handling device **215**. For example, in one embodiment, the notification module **505** receives the sleep notification from the second information handling device **215** in communication with the information handling device **205**. The second information handling device **215** may be the source of the video signal transmitted to the information handling device **205**. In one embodiment, the second information handling device **215** transmits a signal to the sleep notification module **505** through an HDMI connection. For example, a user may be transmitting video from his or her smartphone (e.g. the second information handling device **215**) to a laptop computer (e.g. the information handling device **205**) with an HDMI video connection and may enter a command on the smartphone to put the laptop computer to sleep. The smartphone may transmit the sleep notification to the sleep notification module **505** in response to the user entering the command. In one embodiment, the second information handling device **215** transmits the sleep notification in response to receiving a notification from the information handling device **205** of a window setting change or other indication that the information handling device **205** should be placed into the sleep state. For example, a user may enter a full screen mode with the video on the user's laptop and the laptop computer may transmit a notification that the window has been converted to the full screen mode to the user's smartphone which is transmitting the video signal. The user's smartphone may transmit the sleep notification to the laptop computer.

The sleep module **510**, in one embodiment, enters the information handling device **205** into the sleep state in response to the notification module **505** receiving the sleep notification. The sleep state may comprise one of various low power states of the information handling device **205** and/or an operating system executing on the information handling device **205**. In one embodiment, the sleep state is an Advanced Configuration and Power Interface (ACPI) state such as an S**1**, S**2**, S**3**, or S**4** state. In certain embodiments, the sleep state may comprise any suitable state in which the information handling device **205** and/or an operating system executing and/or managing the information handling device **205** is maintained in a lower power state where at least a subset of components and/or processes of the information handling device **205** and/or operating system are suspended, such as a processor, non-volatile memory, or the like.

In one embodiment, entering the information handling device **205** into the sleep state refers to signaling the information handling device **205** and/or an operating system managing the information handling device **205** to enter into the sleep state, issuing a command to an operating system to enter into the sleep state, or otherwise causing the information handling device **205** and/or operating system to enter into the sleep state.

In one embodiment, the sleep module **510** enters the information handling device **205** into the sleep state using an operating system command, such as an Application Programming Interface (API) call. For example, with a Windows® operating system, the sleep module **510** may use the Windows.Forms.Application object's SetSuspendState command to enter the operating system into the sleep state.

In one embodiment, a video signal passes through the information handling device **205** to a display **230** as the information handling device **205** is in the sleep state. The video signal may be transmitted from the second information handling device **215** as described above. In one embodiment, the video signal passing through the information handling device **205** to the display **230** means that a portion of the information handling device **205**, such as an expansion card, maintains power, and continues to process the video signal while the information handling device **205** and/or operating system managing the information handling device **205** is in the sleep state as described above in relation to FIG. **3**. In one embodiment, the video signal passing through the information handling device **205** further includes the video signal being received, processed, and output to the display **230** as described above in relation to FIG. **3**.

FIG. **6** illustrates another embodiment of an apparatus **600** for a sleep state video interface of an information handling device **205**. The apparatus **600** may comprise one embodiment of the video interface apparatus depicted in FIG. **2**. The

apparatus **600** includes the notification module **505** and the sleep module **510**, which may be substantially similar to the like named modules of FIG. **5**. In addition, the apparatus **600** includes a signal processing module **605**, a video detection module **610**, a window module **615**, and a resume module **620**.

The signal processing module **605**, in one embodiment, receives the video signal and transmits the video signal to the display **230**. The signal processing module **605**, in one embodiment, maintains power while the information handling device **205** is in the sleep state. In one embodiment, the signal processing module **605** continues processing the video signal while the information handling device **205** is in the sleep state and/or passes through the information handling device **205** to a display **230** as the information handling device **205** is in the sleep state. The signal processing module **605**, in one embodiment, comprises one embodiment of the signal processing module **310** described above in relation to FIG. **3**.

The video detection module **610**, in one embodiment, detects the information handling device **205** receiving the video signal. The video signal, in one embodiment, is an HDMI signal. In this embodiment, the video detection module **610** may detect an incoming HDMI signal. In one embodiment, the video detection module **610** communicates with the signal processing module **605** receiving the video signal as described above in relation to FIG. **3**. In one embodiment, the video detection module **610** sends the sleep notification to the sleep notification module **505** in response to detecting the information handling device **205** receiving the video signal. For example, a user may connect a second information handling device **215** to the information handling device **205** and begin transmitting video and the information handling device **205** may enter the sleep state in response to the transmitted video.

The window module **615**, in one embodiment, displays video of the video signal in a window on a user interface of the information handling device **205**. In one embodiment, the window module **615** displays the video in the window in response to the detection module detecting the information handling device **205** receiving the video signal. For example, in one embodiment, the information handling device **205** executes a Windows® operating system from Microsoft® and the window is a window displayed by a user interface of the operating system and/or an application running on the operating system. In one embodiment, the video transmitted by the second information handling device **215** is displayed in the window, which, as described above in relation to FIG. **4**A, may be sized initially as a sub region of the display **230**. The window module **615**, in one embodiment, receives, references, and/or obtains the video signal from the active portion **305** (e.g. the expansion card) and displays video of the video signal in the window.

In one embodiment, the sleep notification comprises an indication of a setting change of the window and the sleep module **510** enters the information handling device **205** into the sleep state in response to the setting change of the window. In one embodiment, the setting change comprises a maximization of the window. In one embodiment, a maximization of the window occurs when the window expands to cover an entire displayable area of the display **230**. In certain embodiments, borders and/or toolbars of the window may remain visible when the window is maximized. In one embodiment, the setting change comprises converting the window into a full screen mode. In one embodiment, the window enters into a full screen mode by expanding to fill the entire displayable area of the display **230**. In certain embodiments, borders and/or toolbars of the window may be hidden during full screen mode and/or a resolution of the display **230** may be changed during a full screen mode. In one embodiment, the window module **615** issues the sleep notification to the sleep notification module **505** in response to detecting a setting change of the window. In one embodiment, the window module **615** detects the setting change of the window from a signal from the operating system indicating the setting change.

The resume module **620**, in one embodiment, receives a resume notification and/or wakes the information handling device **205** from the sleep state in response to the resume notification. The resume module **620** may comprise one embodiment of the resume module **330** depicted in FIG. **3**. In one embodiment, the resume notification includes a notification from a second information handling device **215** in communication with the information handling device **205**. For example, in one embodiment, the second information handling device **215** may transmit the resume notification across the video connection (e.g. the HDMI connection) to the resume module **620**. In one embodiment, the expansion card communicates with the resume module **620** and at least a portion of the resume module **620** comprises a microcontroller that communicates with other components of the information handling device **205** to wake the information handling device **205** from the sleep state in response to the resume notification. Specifically, in one embodiment, the resume module **620** wakes up from the sleep state in response to the resume notification. The resume module **620** may then wake up other components of the information handling device **205** by transmitting additional signals to the other components.

In one embodiment, the resume notification includes a button press and/or one or more keystrokes. In this embodiment, the resume module **620** may be in communication with a keyboard and/or a mouse and may receive input from the keyboard and/or mouse to wake the information handling device **205**. For example, the resume notification may include a certain keystroke combination. If the resume module **620** detects the keystroke combination, the resume module **620** may wake up the information handling device **205**.

FIG. **7** illustrates one embodiment of a method **700** for a sleep state video interface of an information handling device **205**. The method **700** begins and the notification module **505** monitors **705** for a sleep notification to place an information handling device **205** into a sleep state. If the notification module **505** receives **705** a sleep notification, the sleep module **510** enters **710** the information handling device **205** into the sleep state. The video signal, in one embodiment, passes through the information handling device **205** to a display **230** as the information handling device **205** is in the sleep state. The method **700** ends.

FIG. **8** illustrates one embodiment of a method **800** for a sleep state video interface of an information handling device **205**. The method **800** begins and the video detection module **610** monitors **805** for an information handling device **205** receiving a video signal. If the detection module **610** detects **805** the information handling device **205** receive the video signal, the window module **615** displays **805** video of the video signal in a window on a user interface of the information handling device **205**. If notification module **505** does not **815** detect a setting change of the window, the window module **615** continues **810** to display video of the video signal in the window. Alternatively, if the notification module **505** detects **815** a setting change of the window (e.g. the window converts into full screen mode or is maximized), the

sleep module **510** enters **820** the information handling device **205** into a sleep state. The signal processing module **605** processes **825** the video signal while the information handling device **205** is in the sleep state.

If the resume module **620** does not **830** detect a resume notification, the signal processing module **605** continues to process **825** the video signal. If the resume module **620** detects **830** a resume notification, the resume module **620** wakes **845** the information handling device **205** and the method **800** ends.

Embodiments may be practiced in other specific forms. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An apparatus comprising:

a storage device storing machine-readable code;

a processor executing the machine-readable code, the machine-readable code comprising:

a video detection module detecting a first information handling device receiving a video signal from a second information handling device and generating a sleep notification in response to detecting the first information handling device receiving the video signal, wherein the video signal comprises digital video data;

a notification module receiving the sleep notification to place the first information handling device into a sleep state; and

a sleep module entering the first information handling device into the sleep state in response to the notification module receiving the sleep notification, the video signal passing from the second information handling device through the first information handling device to a display as the first information handling device is in the sleep state.

2. The apparatus of claim **1**, further comprising a window module displaying video of the video signal in a window on a user interface of the first information handling device in response to the detection module detecting the first information handling device receiving the video signal.

3. The apparatus of claim **2**, wherein the sleep notification comprises an indication of a setting change of the window and wherein the sleep module enters the first information handling device into the sleep state in response to the setting change of the window.

4. The apparatus of claim **3**, wherein the setting change comprises a maximization of the window.

5. The apparatus of claim **3**, wherein the setting change converts the window into a full screen mode.

6. The apparatus of claim **1**, wherein the notification module receives the sleep notification from the second information handling device in communication with the information handling device, the second information handling device transmitting the video signal to the information handling device.

7. The apparatus of claim **1**, further comprising a resume module waking the first information handling device from the sleep state in response to a resume notification, the resume notification comprising one of a button press, one or more keystrokes, and a notification from the second information handling device in communication with the first information handling device.

8. The apparatus of claim **1**, further comprising a signal processing module receiving the video signal and transmitting the video signal to the display, the signal processing module maintaining power while the first information handling device is in the sleep state.

9. A method comprising:

detecting a first information handling device receiving a video signal from a second information handling device and generating a sleep notification in response to detecting the first information handling device receiving the video signal, wherein the video signal comprises digital video data;

receiving the sleep notification to place the first information handling device into a sleep state; and

entering the first information handling device into the sleep state in response to receiving the sleep notification, the video signal passing from the second information handling device through the first information handling device to the first display as the first information handling device is in the sleep state.

10. The method of claim **9**, further comprising:

displaying video of the video signal in a window on a user interface of the first information handling device in response to detecting the first information handling device receiving the video signal.

11. The method of claim **10**, wherein the sleep notification comprises an indication of a setting change of the window and wherein entering the first information handling device into the sleep state occurs in response to the setting change of the window.

12. The method of claim **11**, wherein the setting change converts the window into a full screen mode.

13. The method of claim **9**, further comprising waking the first information handling device from the sleep state in response to a resume notification, the resume notification comprising one of a button press, one or more keystrokes, and a notification from the second information handling device in communication with the first information handling device.

14. A computer program product comprising a non-transitory storage device storing machine readable code executed by a processor to perform the operations of:

detecting a first information handling device receiving a video signal from a second information handling device and generating a sleep notification in response to detecting the first information handling device receiving the video signal, wherein the video signal comprises digital video data;

receiving the sleep notification to place the first information handling device into a sleep state, wherein the first information handling device comprises a first display and the second information handling device comprises a second display, wherein the first display is larger in size than the second display; and

entering the first information handling device into the sleep state in response to receiving the sleep notification, the video signal passing from the second information handling device through the first information handling device to the display as the first information handling device is in the sleep state.

15. The computer program product of claim **14**, further comprising operations for:

displaying video of the video signal in a window on a user interface of the first information handling device in response to detecting the first information handling device receiving the video signal.

16. The computer program product of claim **15**, wherein the sleep notification comprises an indication of a setting change of the window and wherein entering the first infor-

mation handling device into the sleep state occurs in response to the setting change of the window.

17. The computer program product of claim **16**, wherein the setting change converts the window into a full screen mode.

18. The computer program product of claim **14**, further comprising operations for waking the first information handling device from the sleep state in response to a resume notification, the resume notification comprising one of a button press, one or more keystrokes, and a notification from the second information handling device in communication with the first information handling device.

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